NEW SPECIES AND NEW RECORDS OF COLLEMBOLA (HEXAPODA) FROM THE REPUBLIC OF MOLDOVA

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Abstract. The first results of the Collembola species diversity from natural protected forests in the Republic of Moldova are presented. A total of 50 species, belonging to 35 genera and 12 families were revealed, including three species – *Ceraophysella mosquensis*, *Hypogastrura szeptycki* and *Arrhopalites principalis* new for the Republic of Moldova.

Keywords: collembola, new species, flooded forest, reserve, Republic of Moldova.

Rezumat. Noi specii și noi înregistrări de Colembola (Hexapoda) din Republica Moldova. Lucrarea prezintă primele rezultate ale studiului dedicat speciilor de colembole din pădurile naturale protejate din Republica Moldova. În total au fost identificate 50 de specii de colembole, care aparțin la 35 de genuri și 12 familii, inclusiv trei specii – *Ceraophysella mosquensis*, *Hypogastrura szeptyckii* și *Arrhopalites principalis* noi pentru fauna Republicii Moldova.

Cuvinte cheie: colembolă, specii noi, pădure inundabilă, rezervație, Republica Moldova.

INTRODUCTION

The Pădurea Domnească Reserve is the biggest nature reserve from the Republic of Moldova, which was founded in 1993 with the aim of preserving the most representative natural forest complex of meadows and swamps located in the middle part of the Prut River, conserving and regenerating rare species of plants and animals, ensuring ecological recovery and restoring the biodiversity of natural ecosystems. The reserve stretches along the banks of the Prut River for approximately 40 km, forming the border between the Republic of Moldova and Romania. IUCN protected category (strict nature reserve) (***. https://en.wikipedia.org/wiki/Padurea_Domneasca).

Depending on the degree of flooding and alluvium, several meadow plant associations are highlighted, the largest being the surfaces covered by oaks, poplars and willows. The oaks occupy the surface of 1471.4 ha (26%) and are growing on the highest places near the meadow, at an altitude of 53-60 m above. The willows occupy 455.6 ha, being spread along the riverbed of the Prut River and in some places in the gorges. They covered predominantly sandy and sandy-muddy soils. The poplars occupy 1081.6 ha, covered slightly higher places than the willows and represent a form of transition from willows to oaks (***. http://moldsilva.gov.md).

The Telița Landscape Reserve is a protected area, with Sarmatian calcareous deposits covered by natural forests based on oak in central part of the Republic of Moldova, IUCN protected category (V). The natural area is fragmented and includes several types of ecosystems: oaks on slopes and plateaus with gray soils and clayey alluvial chernozem, forest-steppe slopes with different exposures covered with xerophytic oaks, forest-steppe with xerophytic oaks and white poplar on meadow with alluvial soil.

The present study provides the first report regarding the species diversity of Collembola from the Pădurea Domnească and Telița Landscape Reserves from the Republic of Moldova in which collembolan species have not been studied to date and revealed their ecological preference.

MATERIAL AND METHODS

The study area. The research was carried out in several protected areas:

i) The Pădurea Domnească Reserve (GPS 47°36′35″N 27°23′37″E, el. 55 m) is located in the northern part of the Republic of Moldova in Glodeni and Fălești districts, on the bank of the Prut River (Fig. 1). The reserve occupies an area of 5735.2 ha, of which 4976.8 ha are covered by forest. The natural floodplain forest is formed on the base of oak (*Quercus robur*), poplar (*Populus alba*, *P. nigra*) and willow (*Salix alba, S. fragilis*). In some places there are solitary specimens of ash (*Fraxinus excelsior*), lime (*Tilia cordata*), elm (*Ulmus laevis*). Small areas are occupied with willow-shrub species - *Salix cinerea*, *S. viminalis*, *S. triandra*, *S. purpurea*. Meadow vegetation was formed in places with moderate humidity, excessive humidity, saline places and is covered mainly by hydrophilic plant species (POSTOLACHE & LAZU, 2018).

ii) The Telița Ladscape Reserve (GPS 46°58′16″N, 29°18′11″E, el. 11-79 m), is located to the east of the village of the same name in Anenii Noi district, on a steep slope of the Dniester River (Fig. 2). The reserve includes plots of oaks (*Quercus petraea* and *Q. pubescens*) in combination with mahaleb cherry (*Prunus mahaleb*) and oleaster-leafed pear (*Pyrus elaeagrifolia*) with a surface of 13.6 ha, *Populus alba* with an area of 0.7 ha, of elm (*Ulmus glabra)* - 3.1 ha, ash (*Acer campestre*) - 5.3 ha and acacia (*Robinia pseudoacacia*) plantation - 68.6 ha. The total area covered by stands is 100.9 ha, and clearings occupy 27.1 ha (POSTOLACHE & LAZU, 2018).

Figure 1. Location of the Pădurea Domnească Reserve.

Figure 2. Location of the Telița Ladscape Reserve.

(https://www.google.com/maps, accessed March 21, 2023).

Collection of materials. The collembolan species were collected from the litter, wood decompose and moss of the Pădurea Domnească Reserve in May 5, September, 13, November 2, 2022 and March 27, 2023 (Fig. 3). In the Telița Landscape Reserve material was collected in March 12, 2021, June, 2022 and March 30, 2023 (Fig.4). Collembola were extracted from the litter, moss and wood, using the modified flotation method according to BUȘMACHIU et al. (2015). The specimens were fixed in 96% ethyl alcohol, sorted under a Meiji Techno binocular, cleared in lactic acid and KOH and mounted on permanent slides using Marc André II solution. The specimens were identified at the species level using the LEICA 2500 phase contrast microscope and the following major taxonomical sources: BABENKO et al., 1994, FJELLBERG (1998, 2007) and POTAPOV (2001). The distribution of species is presented according to the Fauna Europaea and FJELLBERG (1998, 2007). The list of species and number of specimens are included. Species which are new for the fauna of the Republic of Moldova are marked in Table 1 with an asterisk (*).

Figure 3. Pădurea Domnească Reserve (original).

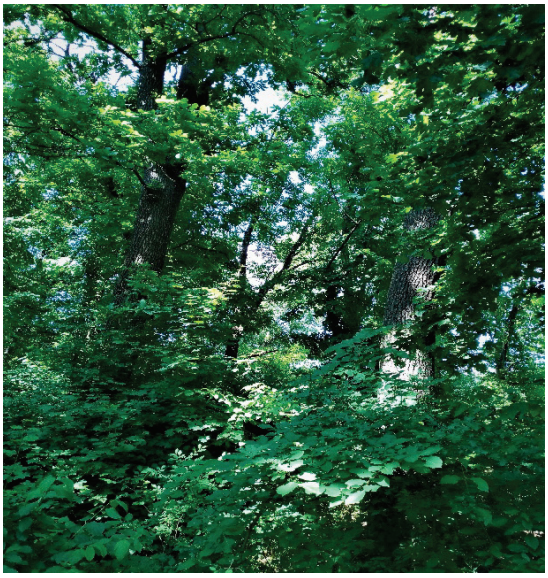

Figure 4. Telița Landscape Reserve (original).

RESULTS AND DISCUSSIONS

As a result of investigation in the Pădurea Domnească and Telița Landscape Reserves, a total number of 50 species of Collembola from 35 genera and 12 families were revealed. In the Pădurea Domnească Reserve – 42 species and in the Telița Landscape Reserve – 17 species of Collembola were identified. Brief information regarding the numbers of individuals, ecological traits and biogeographic distribution is presented for each species (Table 1). Two species – *Ceratophysella mosquensis* and *Arrhopalites principalis* from Pădurea Domnească Reserve are new for the fauna of the Republic of Moldova.

The Entomobryidae family was represented by 11 species, followed by the families Neanuridae – 9, Isotomidae –7 and Hypogastruridae – 6, Onychiuridae and Tullbergiidae with 3 species each, Tomoceridae,

Arrhopalitidae, Katiannidae Neelidae and Sminthuridae – by 2 species each. The family Sminthurididae was represented by one species (Table 1).

The Pădurea Domnească Reserve is located on the bank of the Prut River, has similar ecological settings to the flooded areas covered by natural forests, as well as the Telița Landscape Reserve located on the bank of Dniester River which periodically floods the reserve. The small number of identified species can be explained by the predominant study of moss and decomposed wood, a fact confirmed by the proportion of life forms dominated by 20 epiedaphic, followed by 12 hemiedaphic and 11 euedaphic collembolan species.

In fact, both studied reserves are located in temporarily or periodically flooded areas, so the proportion of moisture-loving species is high.

The studied habitats of the Pădurea Domnească Reserve revealed the large portions of mesophilous (20) and hygrophilous (7) species, two species are meso-hygrophilous, while the others are eurytopic, have no preference (Table 1). Mesophilous (10), xerophilous (2), hygrophilous (1) species prevail in the Telița Landscape Reserve and the other species have no preference.

Most species have a wide geographic occurrence, namely Palaearctic (30%), followed by European (26%), cosmopolitan (20%) and Holarctic species (20%). One species *Arrhopalites prutensis* has a range limited to the Republic of Moldova. In the papers published by BUŞMACHIU (2021) and WEINER & BUŞMACHIU (2022) a total of 273 collembolan species were cited in the country and, with the newly identified species, the number has increased to 276.

Note. Another new species from family Hypogastruridae was identified in the Cobîleni Nature Reserve relatively small protected area (33,5 ha) situated on the bank of Dniester River (BUŞMACHIU & BACAL, 2022). A total number of 35 species, including one *Hypogastrura* sp. identified to genus level, were revealed in this reserve. The consultations with the specialist in Hypogastruridae allow us to confirm a new species for the Republic of Moldova - **Hypogastrura szeptyckii* Skarzynski, 2006. The species was described from the Poland - Pieniny Mountains SKARZYNSKI (2006), then was identified in Ukraine, in the subalpine belt, under the pine tree of Chornohora, in the Carpathians (SKARZYÑSKI & BABENKO, 2009).

Table 1. Collembola species from the Pădurea Domnească Reserve (PDR) and the Telița Ladscape Reserve (TLR) with the overall numbers of collected individuals, ecological traits and biogeographic distribution (BD).

Taxa (Family/Species)	PDR	TLR	Ecological traits	BD
	No. ind.			
Hypogastruridae family				
1. *Cerayophysella armata* (Nicolet, 1841)	64		Epiedaphic, eurytopic	C
2. *Ceratophysella engadinensis* (Gisin, 1949)		51	Epiedaphic, mesophilic, in forest	C
3. **Ceratophysella mosquensis* (Becker, 1905)	13		Epiedaphic, hygrophilic, bryophyte	P
4. *Hypogastrura socialis* (Usel, 1891)	6		Epiedaphic, in forest	P
5. *Hypogastrura viatica* (Tullberg, 1872)		106	Epiedaphic, hygrophilic, antropophilic	C
6. *Xenylla uniseta* Gama, 1963	14		Epiedaphic, xerophilic, bryophyte	P
Neanuridae family				
7. *Anurida ellipsoids* Stach, 1920	6		Euedaphic, hygrophilic, euedaphic	P
8. *Friesea claviseta* Axelson, 1900	4		Hemiedaphic, hygrophilic, cortical	C
9. *Friesea truncata* Cassagnau, 1958	2		Hemiedaphic, in forest	P
10. *Pseudachorutes pratensis* Rusek, 1973		2	Hemiedaphic, eurytpic, mesophilic	E
11. *Pseudachorutes subcrassus* Tullberg, 1871		1	Mesophilic, in forest	P
12. *Deutonura stachi* (Gisin, 1952)	1		Hemiedaphic, mesophilic, in forest	E
13. *Endonura gracilirostris* Smolis, Skarżyński, Pomorski & Kaprus', 2007		24	Hemiedaphic, termophilic	E
14. *Neanura moldavica* Bușmachiu & Deharveng, 2008	2		Hemiedaphic, mesophilic, in forest	E
15. *Neanura muscorum* (Templeton, 1835)	12		Hemiedaphic, hydrophilic, eurytopic	H
Onychiuridae family				
16. *Protaphorura sakatoi* (Yosii, 1966)	23		Euedaphic, xero-thermophilic, eurytopic	E
17. *Protaphorura subarmata* (Gisin, 1957)	8		Euedaphic, eurybiont	E
18. *Oligaphorura absoloni* (Börner, 1901)	7		Euedaphic, mesophilic	H
Tullbergiidae family				
19. *Mesaphorura krausbaueri* Börner, 1901	24	3	Euedaphic, eurytopic	P
20. *Mesaphorura critica* Ellis, 1976	1		Euedaphic, mesophilic, eurytopic	P
21. *Mesaphorura florae* Simon, Ruiz, Martin & Lucianes, 1994	12		Euedaphic, mesophilic	E
Isotomidae family				
22. *Desoria* sp. juv.	1		-	
23. *Folsomia quadrioculata* (Tullberg, 1871)	42	19	Hemiedaphic, xero-thermophilic, forest-grassland	H
24. *Parisotoma notabilis* (Schäffer, 1896)	57	16	Hemiedaphic, mesophilic, eurytopic	C

25. *Proisotoma minima* Axelson, 1901		3	Hemiedaphic, mesophilic, eurytopic	H
26. *Isotoma viridis* Bourlet, 1839	10		Epiedaphic, mesophilic, eurytopic	H
27. *Isotomiella minor* (Schäffer, 1896)	2	32	Euedaphic, mesophilic, eurytopic	H
28. *Vertagopus hagvari* Fjellbeg, 1996	8		Epiedaphic, in forest	P
Entomobryidae family				
29. *Entomobrya dorsalis* Usel, 1891	9		Epiedaphic, mesophilic, grassland	E
30. *Heteromurus nitidus* (Templeton, 1835)	1		Hemieraphic, mesophilic, eurytopic	H
31. *Lepidocyrtus arrabonicus* Traser, 2000		1	Epiedaphic, open space	E
32. *Lepidocyrtus lignorum* (Fabricius, 1775)	4	2	Epiedaphic, mesophilic	P
33. *Lepidocyrtus paradoxus* Usel, 1890	70		Epiedaphic, meso-higrophilic, grassland	P
34. *Lepidocyrtus weidneri* Hüter, 1971	32		Mesophilic, in litter	P
35. *Orchesella multifasciata* Stscherbakow, 1898	59	16	Epiedaphic, xerophilic, forest-grassland	E
36. *Orchesella xerothermica* Stach, 1960	9		Epiedaphic, xero-thermophilic, in forest	E
37. *Pseudosinella horaki* Rusek, 1985	4		Hemiedaphic, xero-thermophilic, forest-grassland	E
38. *Willowsia buski* (Lubbock, 1869)		2	Epiedaphic, xerophilic, cortical	C
39. *Willowsia nigromaculata* (Lubbock, 1873)	7	3	Epieraphic, mesophilic, eurytopic	C
Tomoceridae family				
40. *Pogonognatellus flavescens* (Tullberg, 1871)	22		Hemiedaphic, meso-higrophilic, in forest	H
41. *Tomocerus vulgaris* (Tullberg, 1871)	24	8	Hemiedaphic, mesophilic, in forest	H
Sminthurididae family				
42. *Sphaeridia pumilis* (Krausbauer, 1898)	7		Hemiedaphic, mesophilic, eurytopic	C
Arrhopalitidae family				
43. *Arrhopalites prutensis* Vargovitsh &Bușmachiu, 2015	8		Euedaphic, mesophilic	R
44. **Arrhopalites principalis* Stach, 1945	11		Euedaphic, hygrophilic	H
Neelidae family				
45. *Megalothorax minimus* Willen, 1900	3		Euedaphic, mesophilic, eurytopic	C
46. *Neelus murinus* Folsom, 1896	8	3	Euedaphic, mesophilic, eurytopic	C
Katiannidae family				
47. *Gisinianus flammeolus* (Gisin, 1957)	6		Epiedaphic, forest-grassland	P
48. *Sminthurinus bimaculatus* Axelson, 1902	4		Epiedaphic, mesophilic, eurytopic	P
Sminthuridae family				
49. *Caprainea marginata* (Schött, 1893)	1		Epiedaphic, xero-thermophilic, grassland	P
50. *Lipothrix lubbocki* (Tullberg, 1872)	7		Macrophitobiont, mesophilic, in forest	E

CONCLUSIONS

A total of 50 species of Collembola belonging to 35 genera and 12 families are the first results of the research carried out in the Pădurea Domnească and Telița Landscape Reserves. In fact, both studied reserves are located in temporarily or periodically flooded areas, so the proportion of moisture-loving species is high, especially in the Pădurea Domnească Reserve.

Three new collembolan species *Ceraophysella mosquensis*, *Hypogastrura szeptyckii* and *Arrhopalites principalis* were identified as new for the fauna of the Republic of Moldova. As a result of intensive research in the last thirty years, 276 species of Collembola are currently known in the Republic of Moldova.

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